

In the claims:

Please amend the claims as follows.

- 1 1. (Amended) Method for characterizing a ballistic item including the steps:
 - 2 a. Produce a sequence of digitized passive infrared images of the item
 - 3 at different focus points such that the deepest to the highest features are each
 - 4 in sharp focus in at least one image,
 - 5 b. tag each image with the ID of the item,
 - 6 c. tag each image with specifics of the imaging set-up including the
 - 7 focus position, and size of digitized image array
 - 8 d. store the tagged image sequence in a database
- 1 2. Method of claim 1 with the additional step:
 - 2 e. produce a photomontage from the tagged image sequence in which
 - 3 each section of the montage image is the corresponding section of the image
 - 4 from the tagged sequence in which that section is in sharpest focus
- 1 3. (Amended) Method of claim 1 or 2 with the additional step of replacing [:
 - 2 f. replace] each tagged image in the sequence with a tagged extracted
 - 3 feature image containing only features at least a specified size extracted from
 - 4 the tagged image
- 1 4. (Amended) Method of claims 1, 2, or 3, further comprising [with the
- 2 additional] steps:
 - 3 [g. add] adding to each tag weapon-specific ancillary information
 - 4 including calibre, type of ammunition, direction of twist, number of lands,
 - 5 serial number, and



6 [h. add] adding to each tag incident-specific information including
7 type of crime committed, location where item was found, associated names,
8 method of crime.

1 5. (Amended) Method for identification of a ballistic item including the
2 steps:

- 3 a. characterize the unknown ballistic item by producing a tagged
4 image sequence
- 5 b. compare the image sequence with those contained in a database
- 6 c. determine those sequences in which one or more images are similar
7 to the unknown tagged image sequence
- 8 d. display the similar [pairs] pair(s) of images to a ballistics examiner
9 who reviews the display and rules that the unknown ballistic item is a match to
10 an item in the database if the similar pair(s) of images are sufficiently alike.

1 6. (Amended) Method of Claim 5[. In which], wherein step [f] d is
2 performed automatically by further image processing

1 7. (Amended) Method of Claims 5 or 6 [including also the step:], further
2 comprising the steps:

- 3 [e. compare] comparing the weapon-specific and incident-specific
4 tagging information of the similar image [pairs] pair(s);
- 5 [a. Display] displaying the similarities and dissimilarities in the
6 tagging information along with the images for further consideration[.] by a
7 ballistics examiner who reviews the display and rules that the unknown
8 ballistic item is a match to an item in the database if the tagging information
9 as well as the similar pair(s) of images are sufficiently alike.

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1 8. (Amended) Method of Claim 7 [in which step I], wherein the reviewing by
2 the ballistics examiner is performed automatically by further image
3 processing.

1 9. (Amended) Method for identification of a ballistic item including the
2 steps:

- 3 a. characterize the unknown ballistic item by producing from passive
4 infrared images a tagged extracted feature sequence
- 5 b. compare the extracted feature sequence with those contained in a
6 database
- 7 c. determine those sequences in which one or more extracted features
8 are similar to the unknown extracted feature sequence
- 9 d. display the similar pairs of extracted features to a ballistics
10 examiner who reviews the display and rules that the unknown ballistic item is
11 a match to an item in the database if the similar pair(s) of extracted features
12 are sufficiently alike.

1 10. (Amended) Method of Claim 9[. In which], wherein the reviewing by the
2 ballistics examiner [step d] is performed automatically by further image
3 processing

1 11. (Amended) Method of Claims 9 or 10 [including also], further
2 comprising the steps:

- 3 [e. compare] comparing the weapon-specific and incident-specific
4 tagging information of the similar extracted feature [pairs] pair(s); and



5 [f. Display] comparing the similarities and dissimilarities in the
6 tagging information along with the extracted features for further consideration
7 by a ballistics examiner who reviews the display and rules that the unknown
8 ballistic item is a match to an item in the database if the tagging information
9 as well as the similar pair(s) of extracted features are sufficiently alike.

1 12. (Amended) Method of Claim 11, wherein said comparing step [in which
2 step f. Is] is performed automatically by further image processing.

1 13. (Amended) Method of Claim 1 [including also], further comprising the
2 steps:

3 [e.] heating or cooling the ballistic item to vary its temperature;
4 [f.] producing an image sequence in which both focus and temperature
5 are varied; and
6 [g.] tagging each image with the corresponding temperature.

1 14. (Amended) Method to identify illumination-induced artifacts in visible
2 light photography of ballistic items including the steps:

3 a. Produce visible and IR image sequences of the same ballistic item;
4 b. extract features from each image in each sequence;
5 c. tag as a candidate illumination-induced artifact each feature in a
6 visible image which does not have a corresponding IR feature; and
7 d. tag dark visible artifacts as possible shadows and light artifacts as
8 possible glint.

1 17. (Amended) Method to differentiate manufacturing marks and
2 weapons-related tool marks on shell casings including the steps:

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- 3 a. adjust the focus on the IR camera such that the manufacturing
- 4 marks are in focus;
- 5 b. adjust the temperature of the ballistic item such that the
- 6 manufacturing marks are most distinct from the surrounding area; and
- 7 [b]c. threshold the resulting image to create a template of the
- 8 manufacturing marks to be used for matching or for eliminating the marks
- 9 from that image prior to further matching.

1 18. (Amended) Method to detect residue on a ballistic item, including the
2 steps:

- 3 a. apply a sequence of spectral filters to the IR camera
- 4 b. for each filter, vary the focus to produce an image sequence of
- 5 passive infrared images
- 6 c. extract features from each image in the sequence
- 7 d. compare the feature sets in images which have the same focus
- 8 setting but different spectral filters
- 9 e. display those features which are filter-sensitive as possible residue
- 10 f. Annotate features with likely type of residue based upon the filter
- 11 sensitivity.

1 19. (Amended) Apparatus for characterizing a ballistic item including:

- 2 a. IR camera with lenses and focus control
- 3 b. Mechanism for varying the focus control to produce a sequence of
- 4 images
- 5 c. Image digitizer and storage
- 6 [c]d. Mechanism for tagging images with [ancillary] ancillary
- 7 information

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8 [d]e. Feature extractor
9 [e]f. Processor for characterizing the features
10 [f]g. Processor for creating a montage
11 [g]h. Display
12 [h]i. Mechanism for positioning the item within the camera field of
13 viewl

1 20. (Amended) The apparatus of claim 19 including also the elements:
2 [i.]j. device for heating the ballistic item
3 [j.]k device for measuring the temperature of the ballistic device
4 [k.]l. device for applying optical filters before the camera lens
5 [l.]m. mechanism for tagging the resulting images with temperature
6 and filter datau

1 21. (Amended) Apparatus for identifying a ballistic item including the
2 elements of 20 plus:
3 [m.]n. Database of characterized ballistic items
4 [n.]o. Database matching engine
5 [o.]p. Output or display mechanism

1 22. (Amended) Method for identifying a ballistic item including the steps
2 a. for each montaged infrared image [in the] derived from an unknown
3 item database and [the]a known item database produce a relative location map
4 as follows:
5 b. compute the centroid location for each feature, including all
6 striations, gouges, breech face marks, and firing pin indents, where each
7 striation is considered a separate feature.

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8 c. Compute the distances between each pair of centroids
9 d. Tag the distances with the type of feature represented at each end
10 e. Match the list of tagged distances with corresponding lists for the
11 known item database.

1 23. (Amended) Method for separating manufacturers marks from weapons
2 marks in ballistic images, including the steps:

3 a. heating the ballistic item to [temperature which enhances] enhance
4 the manufacturers marks;

5 b. producing [an] a passive infrared image of the ballistic item;

6 c. producing a template of the areas containing the enhanced
7 manufacturers marks; and

8 d. extracting the template areas to form an image containing the
9 manufacturers marks,

10 [e.] wherein the remaining image [containng] contains no
11 manufacturers marks but [containing] contains weapons marks which did not
12 overlay manufacturers marks.

1 24. (Amended) Method for estimating the volume of grooves, indentations and
2 striations in ballistic items including the steps:

3 a. heat the ballistic item to an elevated temperature

4 b. measure the mean temperature of the item using [the] a radiometric
5 infrared camera

6 c. capture a sequence of passive infrared images as the item cools

7 d. capture for each image the mean temperature using the radiometric
8 camera

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